J. H. Wilkerson & Son Brick Works, 1912 HAER DE-5
Gravel Road off Route 409
Milford
Kent County
Delaware

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Washington, D. C. 20240

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HISTORIC AMERICAN ENGINEERING RECORD

Wilkerson and Son Brick Works

HAER DE-5

Location:	Milford, Delaware. UTM: 18.464080.4307680 Quad: Milford
Date of Construction:	circa 1912, Modified for use 1919-21.
Present Owner:	Abandoned
Significance:	J. H. Wilkerson and Son was one of the last local brick works to operate in Delaware. In 1975, all the original machinery, as well as some later additions, were still in operational positions, providing access to the type of plant which dominated the United States brickmaking industry in the early part of this century.
Historian:	Christopher Derganc , 1976.

Brick manufacturing in this country has been, historically, a highly decentralized industry serving local markets. In 1925, generally considered the last so-called "boom year" for the industry, over 1,500 plants produced an average output valued at only $117,500 each. [1] The great bulk and low value of both raw materials and finished product was a major factor in plant location, causing manufacturers to build plants close to clay supplies as well as potential markets. [2]

Since early in this century, the number of brick works has declined steadily, very likely due to the development and widespread use of reinforced concrete as a building material. [3] By 1967, there were only 482 plants in the United States, compared with 2,177 in 1914. [4] Numerous small brick works have been forced out of business, leaving relatively few large plants to produce the brick and structural clay products now used.

In Delaware, there is only one brick work still operating: the Delaware Brick Company of Wilmington. [5] One of the last of the smaller works to close was J. H. Wilkerson and Son, which began in 1912 as a local construction firm in Milford. [6] In April 1919, James H. Wilkerson and his son, C. Van Nuis, bought the Milford Brick Company, valued at over $2,500. [7] The Wilkersons apparently felt there were "possibilities" in the brick industry because they left the construction business and began fulltime brick production. [8] The plant's machinery at the time of purchase, all from the J. C. Steele and Sons of Statesville, North Carolina, consisted of a No. 3 End Cut Brick Machine, a No. 3 Auto Rotary End Brick Cutter, a No. 2 Disintegrator and a Clay Elevator. [9] A 65-horsepower steam engine of unknown manufacture powered the entire plant. In May 1919, the Wilkersons added a No. 1 Hoisting Drum (Model A), two 24-inch Lift Cars and two 24-inch Transfer Cars, also from Steele. [10] Through the years, other equipment, including a clay disintegrator, an even feeder, a pugmill, several clay elevators, and a number of spare machines, were acquired. Although unverified, it is quite possible that these were also from Steele. By 1927, the capital value of the firm had increased to more than $10,000. [11]

The Wilkerson plant supplied both common and face brick to a variety of customers within a forty mile radius of Milford. Operations continued, with few technological improvements, until the local clay deposit was exhausted in the mid-1950s. [12] For several years, clay was purchased from a nearby company, but this soon proved unprofitable and the works were finally abandoned in 1957. [13]

J. H. Wilkerson and Son is significant because the site represents a number of processes dating from the late 19th century. [14] Although in 1975 the plant was in ruins, virtually all the equipment was still in operating position, located under a crude, galvanized-iron shed. It was a fine example of the now almost unknown small brick work, the type of plant that once dominated the industry.

Brick production required 5 major steps: clay excavation, clay preparation, brick forming, drying and burning. Each step could be completed by various means, depending upon the individual brick work. A HAER team interview with Mr. Charles Wilkerson (the grandson of James H. and the last owner of the plant) [15] produced the description of methods employed at J. H. Wilkerson and Son that follows.

The first step in producing brick was the excavation of raw material, clay. Wilkerson's plant was located adjacent to a surface clay deposit on the Mispillion River. [16] All other production work was stopped while a full supply of clay was "laid in". [17]

Originally, dynamite was used to loosen a "bench" of clay, which was then hand loaded into horse drawn, "hopper type" rail cars for transport to a sheet metal storage shed. Three holes, about 10 feet apart, were drilled into the clay bank, 3 feet from the bottom. Three sticks of dynamite were placed in each hole and detonated. The blast produced cracks in the top ledge large enough to enable a man to wedge in a 1-inch diameter bar and pry loose the bench to be broken up and loaded. The rail cars were pulled to a point above the storage area; their beds were tilted; and the clay dumped. When brick production resumed, the clay was again hand loaded onto a conveyor belt which carried it to the main disintegrator.

In the late 1930s, a Bay City power shovel was purchased to dig and load the clay into a dump truck for transport to dig and load the clay into a dump truck for transport to the works. [Photo DE-5-9] The clay no longer went directly to storage. The truck dumped it into a 3 foot by 5 foot steel trough containing 4 screw type augers. [Photo DE-5-11] This "even feeder" reduced the large clay chunks to a size more easily handled by the continuous belt conveyor [Photos DE-5-12, 13] which ran to a preliminary roll-type disintegrator. The disintegrator crushed the clay to a sand like consistency, creating more surface area to facilitate later mixing. Another continuous belt conveyor then moved the clay to a series of two in-line bucket elevators which carried it into the storage shed. [Photos DE-5-7, 14] Two men, one running the power shovel and driving the truck, and one tending the even feeder, took 3 to 4 days to entirely fill the shed. During this time, the remainder of the 20 man crew loaded or unloaded the kiln, or performed various maintenance functions around the yard. Power for the even feeder, disintegrator and elevators came from an in-line 6 cylinder Autocar gasoline engine, salvaged from a wrecked truck.

Once the shed was full, the next step, the actual making of bricks, began. Wilkerson employed the "stiff mud" process. The clay was forced through an extrusion die in a continuous column and then cut to length. Other processes used elsewhere (depending on the type of available clay) included the "soft mud" process, in which the highly plastic clay was shaped in separate molds; and the "dry clay" process, in which the dry clay was formed into brick by being subjected to high pressure, again in individual molds. [18] When making face brick (used to front a building), Wilkerson "re-pressed" the brick formed by the stiff mud

machine in a Carnell hand press. [Photo DE-5-35] This extra step was necessary to obtain the greater uniformity required of face brick.

Clay was taken from the shed by means of a "drag line scoop," powered by a 4 cylinder Hercules stationary gasoline engine purchased and used in the early 1940s. The scoop pulled by a length of wire rope attached to the No. 1 Hoisting Drum, moved along a narrow gauge rail line, to the base of the main bucket elevator. At this point, the clay was dumped into another even feeder located directly above the No. 2 Disintegrator, for additional pulverization.

The main bucket elevator then carried the clay into another rectangular steel trough leading to the "pugmill." [Photos DE-5-15, 17] Within the pugmill was a single shaft with approximately 20 knives set out at right angles. [Photo DE-5-18] The purpose of this machine was to "pug" or temper the clay with water and to reduce the mixture to a homogenous mass. [19] Water was added to obtain the necessary consistency before the clay was fed into the No. 3 Brick Machine immediately below. [Photo DE-5-19]

The brick machine utilized a screw type auger to force the moist and now pugged clay through a self-lubricating 2-1/2 inch by 3-3/4 inch die. [Photo DE-5-20] An excerpt from a 1913 Chambers Brothers catalogue describes the lubrication of a typical die:

> Oil is applied in the back portion of the die, just as the mass of clay is being reduced to a rectangular form. It not only aids in securing a smooth clay bar but relieves the brick machine of strain and saves some power. [20]

Just after the clay passed through the die, it was "sanded"--sprayed lightly with a combination of fine sand and red dye. The sand was obtained from under the clay pit, near the water table. It was rolled, screened and sun dried before being mixed in a 10 to 1 ratio with red pigment, supplied by the C. K. Williams of Easton, Pennsylvania. The purpose of this mixture was to add color and aid in the later handling of the cut brick. [21]

The clay column left the die and was carried by a continuous belt conveyor to the No. 3 Auto Rotary End Brick Cutter [Photos DE-5-16, 17, 22]. This cutter utilized two 5-pointed stars to support a series of cutting wires across the column. Again, an exerpt from the same Chambers Brothers catalogue describes the action of the cutter:

> The cut off wires are strained on steel bows or springs to to the proper tension to cut, and yield readily to obstructions. . . . The wires are carried by their springs on a sprocket-wheel over and through the clay bar, and are guided by a cam encased in a dirt-tight case. The partly severed brick is supported and held against the clay bar until the operation is completed, when it is dumped on to the off bearing belt and promptly carried off, thus permitting the return of the wire above the clay bar again between the brick and the end of the bar. [22]

By 1952, a 150 horsepower stationary International Harvester diesel engine had replaced the steam engine and powered the brick machine, pugmill, main elevator, and cutter.

Four men, two on each side of the off-bearing belt, loaded the 8 1/2 inch long "green" bricks onto pallets for movement to the drying sheds. The green bricks were stacked 8 high, 222 to a pallet. A narrow-gauge, flat bed rail car was brought underneath the off-bearing table and its bed raised to remove the pallet. [Photo DE-5-23] This so-called lift car was then moved by two transfer men onto another narrow gauge flat-bed car. [Photo DE-5-24] The transfer car ran on tracks perpendicular to those on the off-bearing platform and within the sheds. There were 10 drying sheds, each approximately 150 feet long and containing two sets of tracks. The lift car was taken off the transfer car and into the sheds where the pallets were off-loaded for drying. [Photo DE-5-8]

The Wilkerson brick work utilized exclusively open-air drying, although there were several more efficient methods available, including artificial heat and the use of waste heat from the kiln. [23] This may be explained, at least in part, by the fact that J. C. Steele and Sons, their primary source of equipment, extensively promoted the open-air drying method as the best and most economical. [24]

The kiln itself was a rectangular, up-draft, "Dutch Oven" type, approximately 25 feet by 40 feet. [25] [Photos DE-5-3, 4, 5, 6, 25, 26] It was constructed of brick (hard burned half way up and softer brick to the top) with 20 arch-like openings along the sides and a narrow "door" at one end. There was a metal V-type roof, suspended over the center by pine timbers and a series of cables, which extended 8 feet from either side of center. From that point, 1 foot by 12 foot pine boards were laid to the kiln walls, about 2 to 3 inches apart. Over the spaces were placed pine "lap boards" of the same size. These were left covering the kiln until the sap began to run (an indication that the boards were about to burn), at which point they were removed and the kiln left uncovered. The function of the boards was to keep rain off the bricks during the first few days of the firing, until they were hard enough to resist rainwater. They were not intended to retain heat and were usually removed within three days.

Bricks were taken from the drying shed on a transfer car and stacked in the kiln, so as to create arches or firing chambers across the width, with openings along the sides. [Photos DE-5-28, 29] The description of the stacking process that follows was taken from the Brick and Clay Record, a leading trade publication in the field early in the century. It is a general description and it must be noted that the procedure followed by the Wilkersons probably differed slightly. Unfortunately, an accurate description of the Wilkerson procedure was not available. [26]

> The number of brick in an arch varies from 35,000 to 40,000. Each arch is from 40 to 60 courses high and in most yards, fifteen arches make up a kiln. [Wilkerson's kiln had 10.]
>
> The open portion of the arch is about fourteen courses high, the brick above the arch are set three one way and three on top

at right angles. They are kept slightly separated by putting small pieces of clay between them. The first row of brick on top of the arch is called the tie course and the first fourteen courses, including the tie course, over the arch are called the lower bench and the rest of the courses above are called the upper bench. [27]

Stacking the 250,000 brick per firing required 6 men, 3 tossers and 3 setters, and took 10 days to complete. The entrance to the kiln was sealed with two rows of brick and then daubed with mud to make it airtight. Before stacking, the entire interior surface of the kiln had been likewise sealed. The kiln was then ready for firing.

Firing required round-the-clock attention from 3 shifts of men each. Each shift consisted of a fireman, who was responsible for the "burn,"and 2 helpers. The first step in the firing process lasted from 1 to 1-1/2 days and was known as water smoking.[28] Any moisture remaining within the brick was forced out at a relatively low temperature as steam. Pine slabwood (later corncobs, when the pine became scarce) was placed in the chambers and ignited with torches (rolled newspapers soaked in kerosene). The burning slabwood acted as a starter for the primary fuel, coal. When the plant changed fuel in the early 1950s, No. 2 heating oil was used as a starter for the much heavier primary fuel, No. 5 heating oil. [Photo DE-5-27] It would normally take about 30 to 40 minutes before the coal was burning; No. 5 oil was ignited after the first day.

With coal, the entire burn took from 5 to 6 days. If the burning continued for too long a period, the bricks would fuse and become unsalable. As it was, during a normal burn, those bricks in the arches near the fire tended to fuse anyway, while those near the top were under-burned. The over-burned bricks, or "clinkers," were sometimes broken apart and used because of their exceptional hardness. [29] The under-burned, or "salmon" bricks were reburned in the next firing. To determine when to cease firing, cast iron knives from the pugmill were hung from the four corners of the kiln. Shrinkage during the firing would cause the bricks to settle. When settlement had reached 16 to 18 inches (the knives were used to judge this measurement), the bricks were considered well-burned. The kiln was then allowed to cool for 10 days before brick removal. The well-burnt bricks were removed and stacked outside for shipment, while the salmon bricks were stored in a shed to await the next burn. Sixty to seventy tons of coal, or 14,000 to 15,000 gallons of oil were consumed during each firing. The plant had 4 to 5 firings a season, which ran from April to October, yielding a yearly output of from 1,000,000 to 1,250,000 bricks.

In 1919, there were 11 producing brick works in the state of Delaware, with an average output of just over $20,000 each. [30] None from this group remained in operation in 1975 (the Delaware Brick Company was not founded until after World War II), reflecting the industry-wide trend towards consolidation, and away from the local brick work. J. H. Wilkerson and Son was the last of these small works to operate, and with all machinery intact, it provided access to

a type of plant no longer extant.

Wilkerson was not a technologically innovative firm, nor was it particularly significant in and of its own. It continued to employ methods dating from the late 19th century (e.g., open-air drying, hand movement of materials; single, Dutch Oven type kiln) well into the 20th century. It is, however, one of the last representatives of an earlier era in brickmaking, an era when the local plant was the dominant force within the industry.

NOTES

[1] Biennial Census of Manufactures: 1925 (Washington, 1928), cited by Alfred J. Van Tassel, Mechanization in the Brick Industry (W.P.A. National Research Project, Report No. M-2, Philadelphia, 1939), p. 1.

[2] Tile and Clay Products Industry: Plant Location Factors (New York: Metropolitan Life Insurance Company, Policyholders' Service Bureau, 1931, pp. 1-19), cited by Van Tassel, Mechanization, p. 1.

[3] See Biennial Census: 1925 and Census of Manufactures, 1967 (Washington, 1971); In 1914, the total value of all clay products produced was $333,730,000; that of all concrete products was $75,214,000 (Biennial Census: 1925, pp. 858-59). In 1967, the total value of brick and structural clay products increased to almost $515,000,000, while the value of ready mixed concrete alone totaled $2,684,200,000 (Census: 1967, pp. 32B-5, 32D-6).

[4] Abstract of Census of Manufactures: 1914 (Washington, 1917), p. 202. This figure is for plants producing brick only.

[5] Pickett, Thomas E., Delaware City Resources (Pittsburgh, U. S. Bureau of Mines, 1970), p. 2.

[6] HAER oral interview with Charles Wilkerson, 30 June 1975.

[7] Thomas' Register of American Manufactures (New York, Thomas Publishing Company, 1918), col. 968.

[8] HAER interview with Mrs. C. Van Nuis Wilkerson, 9 July 1975.

[9] Correspondence between C. S. Derganc and Clarence Steele, 30 June 1975.

[10] Ibid.

[11] Thomas' Register, 1926/27, col. 1031.

[12] Several machines were added, but the only process changes were the acquisition of a power shovel for clay excavation (pp. 5-7) and the switch from coal to oil as kiln fuel (pp. 15-16).

[13] HAER interview with Charles Wilkerson, 30 June 1975.

[14] This was not necessarily unique to the Wilkerson plant; changes came slowly in the brick industry, especially in the smaller plants. The extremely slim profit margin did not allow for rapid, sweeping change. However, the Wilkerson work was less advanced than most (See "Clay Working Machines of the Past and Present," Brick and Clay Record,

vol. XLIII, No. 2, 15 July 1913, pp. 135-144). In fact, Charles Davis, in his Practical Treatise on the Manufacture of Bricks, Tiles, Terra-Cotta, etc. (1884), describes a number of the processes employed by Wilkerson.

[15] Mr. Wilkerson now runs a fuel oil and brick distribution business on a site adjacent to the remains of the brick work.

[16] The quantity of this deposit is today unknown, but an earlier brick work, located near to the Wilkerson site on the Mispillion River was said to possess clay, "pronounced by competent judges the best in the State, south of Wilmington." (Edwards, Richard, ed., Industries of Delaware, Wilmington, 1880, p. 1555).

[17] Before the plant acquired a power shovel in the late 1930s, the entire work crew was needed to dig the clay. After the acquisition, the practice seems to have been continued (although Mr. Wilkerson gave contradictory accounts of this), possibly in order to perform regular machinery maintenance.

[18] Van Tassel, Mechanization, p. 2.

[19] Ceramic Products Cyclopedia, (New York, 1928), p. 21.

[20] Chambers Brothers, Catalogue-24 (Philadelphia, 1907), p. 21.

[21] Iron oxide, found in most clays, is converted to peroxide when burned. Peroxide has a reddish tint which imparts the usual color to brick. Dye was used to further enhance the red color. The lubricating oil applied in the die made the bricks very slippery and the sand was applied to counteract this.

[22] Chambers Brothers, Co., Catalogue, p. 30.

[23] See Ceramic Products Cyclopedia, pp. 44-60.

[24] See Steele Company advertisement on drying enclosed. There are many such ads in various issues of the Brick and Clay Record.

[25] This was probably the least expensive type of kiln to build.

[26] Mr. Wilkerson gave at least two different accounts of the stacking procedure; both differed from what the HAER survey team was able to deduce from the remains of the two fused arches still in the kiln.

[27] Beals, Allen E., "Kiln Problems of Eastern Producers," Brick and Clay Record, vol. XLI, No. 4, 15 August 1912, p. 137.

[28] The full temperature of the kiln was not reached until the middle of the second day. Therefore, water smoking was not done as a separate process with the temperature artificially kept low, it was merely a stage of the firing procedure.

[29] The clinkers were similar to fire brick which is made extremely hard to be used as furnace linings or in other applications requiring resistance to severe heat. The Wilkersons did not produce this type of brick intentionally. Their normal product line was restricted to common and face brick. The clinkers were occasionally used for foundation linings, fences, fireplace brick and to line the lower portion of the kiln walls.

[30] Fifteenth Census of the United States Manufactures: 1929, vol II (Washington, 1930), p. 841.

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Historic American Engineering Record interview with Mrs. C. Van Nuis Wilkerson. 9 July 1975. Untaped.